Package ‘designr’

May 25, 2020

Type Package
Title Balanced Factorial Designs
Version 0.1.10
URL https://maxrabe.com/designr
BugReports https://github.com/mmrabe/designr/issues
Description Generate balanced factorial designs with crossed and nested random and fixed effects <https://github.com/mmrabe/designr>.
License GPL-3
Encoding UTF-8
LazyData true
RoxygenNote 7.1.0
Imports MASS, tibble, crossdes, methods, dplyr
Suggests knitr, rmarkdown, jsonlite, writexl
VignetteBuilder knitr
NeedsCompilation no
Author Maximilian Rabe [aut, cre],
      Reinhold Kliegl [aut],
      Schad Daniel [aut]
Maintainer Maximilian Rabe <maximilian.rabe@uni-potsdam.de>
Repository CRAN
Date/Publication 2020-05-25 11:00:02 UTC

R topics documented:
  +,factorContainer,factorContainer-method ........................................ 2
design.contrasts ................................................................. 3
factor.design ................................................................. 4
factorContainer-class ......................................................... 5
factorDesign-class .......................................................... 6
description

By adding factors and designs by +, a new design is created that contains all of the components.

Usage

```r
## S4 method for signature 'factorContainer,factorContainer'
e1 + e2
```

Arguments

e1, e2 factor containers, such as factors or designs

Value

A factorDesign object

Examples

```r
des <- fixed.factor("Factor1", c("1A","1B")) +
fixed.factor("Factor2", c("2A","2B")) +
random.factor("Subject", c("Factor1"))
```
design.contrasts

Retrieve contrast codes for a design

Description

This function can be used to retrieve contrast codes based on experimental codes / planned observations.

Use this function to retrieve the names for contrasts in an experimental design, such as used by lm, lmer and many other regression models.

Usage

design.contrasts(
  design,
  factors = names(fixed.factors(design)),
  contrasts = NULL,
  expand = TRUE,
  rename_contrasts = "%1$s%2$s",
  intercept = FALSE,
  interactions = FALSE,
  include_random_levels = FALSE
)

column_names(design, ranfac = NULL, as_symbols = FALSE, ...)

Arguments

- **design**: A design object
- **factors**: Which fixed factors to include in the output
- **contrasts**: Contrasts to use for each categorical factor. Should be a list named after the fixed effects and containing contrast matrices, such as the ones generated by the standard contrast functions. If NULL or the fixed factor is not found in the list, default contrasts are used (typically, treatment contrasts).
- **expand**: If TRUE, a design matrix is returned. If FALSE, all factors (and interactions) with their respective levels are returned.
- **rename_contrasts**: This is the pattern after which columns in the design matrix are named. By default, this is a direct concatenation of factor name and contrast name.
- **intercept**: If TRUE, an intercept is added to the matrix. Its value is 1 for all observations.
- **interactions**: If TRUE, interactions of fixed factors are included.
- **include_random_levels**: If TRUE, levels of random factors are included in the matrix.
- **ranfac**: Return random-effects contrast names for a given random factor. If NULL, return fixed-effects contrast names.
- **as_symbols**: Return contrast names as symbols rather than strings (character vectors).
- **...**: Arguments to pass on to design.contrasts()
factor.design

Value
A design matrix (if expand==TRUE, default) or a list of factor levels (if expand==FALSE) for
design.contrasts or contrast names for contrast.names.

Functions
• contrast.names: Retrieve contrast names for a design

Examples

```r
des <- fixed.factor("Factor1", c("1A","1B")) +
    fixed.factor("Factor2", c("2A","2B")) +
    random.factor("Subject", c("Factor1"))

design.contrasts(des)
contrast.names(des)
stopifnot(contrast.names(des) == c("Factor11B", "Factor22B"))
contrast.names(des, as_symbols = TRUE)
design.contrasts(des, contrasts = list(Factor2 = contr.sum))
contrast.names(des, contrasts = list(Factor2 = contr.sum))
```

factor.design  Factorial Designs

Description
The main function of this package is to create factorial designs with this function.

Usage
factor.design(...)

Arguments
... Factors to add to the design.

Value
An instance of factorDesign with the complete factorial design and all fixed and random factors.
factorContainer-class

See Also

random.factor and fixed.factor for creating factors to add to the design. output.design and write.design for creating a useful summary and writing it into output files.

Examples

# To create an empty design:
design <- factor.design()

# To create a design for a recognition memory experiment in
# which each participant only sees either picture or words:
design <- factor.design(
  fixed.factor("type",levels=c("pic","word")),
  fixed.factor("status",levels=c("old","new")),
  random.factor("subject", groups="type"),
  random.factor("item", groups="type"),
  random.factor(c("subject","item"), groups="status")
)

# This is identical to:
design <- fixed.factor("type",levels=c("pic","word")) +
  fixed.factor("status",levels=c("old","new")) +
  random.factor("subject", groups="type") +
  random.factor("item", groups="type") +
  random.factor(c("subject","item"), groups="status")

# Or:
design <- factor.design(~type(pic,word)+status(old,new)+subject[type]+item[type]+subject:item[status])

# You can also create a new design by adding more factors to an existing one:
design1 <- factor.design(~type(pic,word)+status(old,new)+subject[type]+item[type])
design2 <- design1 + random.factor(c("subject","item"), groups="status")

factorContainer-class  Design matrix S4 functions

Description

Design matrix S4 functions

Usage

## S4 method for signature 'factorContainer'
show(object)
Arguments

object A factorDesign object.

Methods (by generic)

• show: Display a factor container

Examples

```r
des <- factor.design()
des <- fixed.factor("Factor1", c("1A","1B")) +
       fixed.factor("Factor2", c("2A","2B")) +
       random.factor("Subject", c("Factor1"))
```

factorDesign-class

S4 Methods for designFactor

Description

S4 Methods for designFactor

Arguments

x a factorDesign

Examples

```r
x <- fixed.factor("Factor1", c("1A","1B"))
y <- random.factor("Subject", c("Factor1"))
```

fixed.factor

Fixed factors

Description

This function creates an instance of fixedFactor to be used in a factorDesign. Fixed factors typically relate to (quasi-)experimental factors such as experimental conditions/manipulations, subject/item characteristics etc.
fixed.factor

Usage

fixed.factor(
  name,
  levels,
  blocked = FALSE,
  character_as_factor = TRUE,
  is_ordered = FALSE,
  block_name = "%1$s.%2$d",
  groups = character(0),
  replications = 1L,
  assign = "latin.square",
  ...
)

Arguments

name
  Name of the fixed factor.
levels
  If not grouped, a vector of factor levels. Any atomic data type (character, logical, numeric, integer) can be used. If grouped, this should be a named list with each entry being a vector (as described before) and its name being a value of the grouping factor(s). If grouped within several factors, i.e. an interaction, the values constituting the names should be concatenated by colons (:), e.g. list('f111:f211'=1:2,'f112:f211'=3:4,...). If for any group there are no levels specified, a warning will be issued and NA will be assigned as the value for this factor. If this is intended and the warning should be suppressed, please explicitly assign NA as the value for that group, e.g. list('f111:f211'=1:2,'f112:f211'=NA,...).
blocked
  Set this to TRUE if the levels of this factor are blocked. In that case, a factor is created whose factor levels are different sequences of the levels specified in the function call.
character_as_factor
  If this is TRUE, character vectors passed in levels are automatically converted to a factor type.
is_ordered
  Is this an ordered factor?
block_name
  If blocked = TRUE, by default, there is not only a design matrix column created that contains the complete sequence of block levels but also a column for each position of the sequence with its assigned level. You may specify a different naming pattern using sprintf naming conventions. The first argument passed is the factor name and the second argument is the sequence position (starting at 1). The default column names will be factor.1, factor.2, etc. If NULL, no additional block columns are created.
groups
  Names of fixed factors in which to nest this fixed factor (see *Nesting fixed factors*).
replications
  Either a single integer or an integer vector of the same length as levels that is used to determine how many times each factor level should be repeated.
assign
  If blocked = TRUE, you may specify a different method of rotating levels. The default if 'latin.square' but 'permutations', 'williams', and 'random.order' are also available.
Nesting Fixed Factors

If `groups` is used, the function will attempt to nest levels of the newly created factor within levels/interactions of the specified grouping factors. Note that nesting of fixed effects is only allowed within other fixed effects combinations but not within random effects. For each combination of the grouping factors, e.g. each group, you should specify an individual vector of levels (see above). If you fail to supply levels for any group, NAs will be assigned. This could result in unpredicted behavior when more factors are added. If you know what you are doing and would like to suppress the warning, please explicitly specify NA as the (only) value to assign to that group. At any rate, it is highly recommended to run sanity checks on the balancedness of the design if you are nesting fixed factors!

See Also

`random.factor`

Examples

```r
fixed.factor("correct", levels=c(TRUE, FALSE))
fixed.factor("age", levels=c("child", "youth", "adult"))
fixed.factor("order", levels=c("task1", "task2", "task3"), blocked = TRUE, assign="latin.square")
```

Description

Check if argument is a design factor (either random or fixed factor), specifically a random factor, a fixed factor or a factor design.

Usage

```r
is.randomFactor(fac)
is.fixedFactor(fac)
is.factorDesign(fac)
is.designFactor(fac)
```
Arguments
fac Object to check.

Value
TRUE or FALSE

Functions
- is.randomFactor: Check if argument is a random factor.
- is.fixedFactor: Check if argument is a fixed factor.
- is.factorDesign: Check if argument is a factor design.

Examples

```r
x <- fixed.factor("factor", c("level1","level2"))
y <- random.factor("factor")

stopifnot(is.fixedFactor(x) && !is.randomFactor(x))
stopifnot(!is.fixedFactor(y) && is.randomFactor(y))
stopifnot(is.designFactor(x) && is.designFactor(y))
```

Description
Retrieve the number of observations

Usage
```
## S4 method for signature 'factorDesign'
nobs(object)
```

Arguments
object A designFactor object

Value
The number of observations
Examples

```r
des <- fixed.factor("Factor1", c("1A","1B")) +
      fixed.factor("Factor2", c("2A","2B")) +
      random.factor("Subject", c("Factor1"))

nobs(des)

stopifnot(nobs(des) == 4)
```

**Description**

These functions return useful summaries of a factor design, including the design matrix itself as well as other parameters and a list of random factors as experimental units.

**Usage**

```r
output.design(design, group_by = NULL, order_by = NULL, randomize = FALSE, rename_random = TRUE)

design.formula(design, contrasts = NULL, expand_contrasts = !missing(contrasts), interactions = TRUE, intercepts = TRUE, response = "dv", env = parent.frame())

design.units(design, rename_random = TRUE, include_interactions = FALSE)

design.codes(design, group_by = NULL, order_by = names(random.factors(design, include_interactions = FALSE)), randomize = FALSE, rename_random = TRUE)
```
output.design

Arguments

design The factorDesign object to summarize.
group_by If not NULL, the design matrix is grouped by these factors. Factors must be valid columns of the design matrix. If used, $codes will be a list matched to the entries in $groups.
order_by If not NULL, output within each output group is ordered by these columns.
randomize After ordering, remaining rows in the same order rank are randomly shuffled.
rename_random Should random factor levels be renamed? If TRUE, levels are renamed as strings composed of the factor name and factor level (e.g., Subj01, Subj02, ...). FALSE disables renaming of random factor levels. Alternatively, you may provide a function which should accept the vectorized ID (integer) as a first argument and the name (single character value) of the random factor as second argument or ignore it. Functions such as as.double or as.integer *are* possible because they ignore the second argument and only convert the ID.
contrasts The contrasts to override (NULL if none to override)
expand_contrasts If TRUE, factors with more than one contrast are replaced by so many contrasts, i.e. the result contains the names of the individual contrasts, not of the factors.
interactions Should fixed effects be additive or interactive?
intercepts Should an intercept be included?
response The left-hand side of the equation. Typically, this is just the response/dependent variable.
env The environment in which to embed the formula
include_interactions Whether to include random factor interactions (i.e., counterbalancing factors) in the output

Details

The function design.units returns the experimental units of the design. Those are defined by random factors and their levels. See units return value below.
design.codes returns a dataframe or tibble of all planned observations including each observation’s experimental codes, i.e. fixed and random factor levels. If you group the output, a list is returned. See codes return value below.
design.formula returns a list of formulas suitable for regression analysis. Currently, formulas for lm and lme4 are returned. See formulas entry.

Value

output.design returns a list containing all output summaries, including the following named entities:

codes Either a tibble with all experimental codes or a list of tibbles of experimental codes. The list entries are matched to the rows of $groups.
random.factor

Description

This function creates an instance of `randomFactor` to be used in a `factorDesign`. A random factor is typically related to an experimental unit such as Subject, Item, Experimenter, etc. and does not have preset levels.
random.factor

Usage

random.factor(
  name,
  groups = character(0),
  instances = 1L,
  assign = "latin.square",
  ...
)

Arguments

name          Name of the random factor as a character vector. Typically, this should be a length-1 vector (i.e., a single string) but you may pass multiple names of random factors whose interaction is to be nested in groups (see *Assignment Constraints*).
groups        Names of fixed and random factors that are to be used as grouping (nesting/between) levels.
instances     Number of times (as a single integer value) each level (instantiation) is to be replicated.
assign        For random factor interactions, use this method for counterbalancing instance assignment (see Assignment Constraints)
...           Additional arguments to be stored as extra values.

Value

An instance of the class randomFactor.

Nesting Random Factors

A typical case of nesting in a psychological experiment is to vary a factor between subjects. That means that each subject would only be assigned to one condition of the nesting fixed factor (such as type of instruction). All other fixed factors that are not listed under 'groups' are considered to vary within the random factor. Note that nesting increases the number of replications of the random factor.

Note that a random factor may be nested within fixed and/or other random factors but fixed factors may only be nested within levels of other fixed factors.

Assignment Constraints

A random interaction (a random factor instantiated with more than one name) governs the assignment of the co-occurrence of the listed random factors. That means that, for example, random.factor(c("Subject","Item")) ensures that the assignment of a Subject and Item to one another occurs in only *one* of the conditions of correct. You may use assign = '...' to provide the method to counterbalance the assignment. By default, 'latin.square' is used but you may also use 'random.order' or 'permutations'. Note that, depending on the assignment method you use, the constituting random factors (in this case Subject and Item) will be replicated n-times (n being the number of conditions of the nesting factors) for 'latin.square' and 'random.order' and n!-times for 'permutations'.

random.factors

See Also

fixed.factor

Examples

# A random factor Subject that nests factors blockOrder and gender,
# i.e. blockOrder and gender are "between-subject"
random.factor("Subject", groups=c("blockOrder", "gender"))

# A random factor Item without any grouping
random.factor("Item")

random.factors Extract factors by type

Description

From a given design, extract contained random or fixed factors as a list.

Usage

random.factors(design, include_interactions = TRUE)
fixed.factors(design)

Arguments

design The factor design to check.
include_interactions
Should random factor interactions be included?

Value

A list of factors that are either fixed or random.

Functions

• random.factors: Return fixed factors
Examples

des <- fixed.factor("Factor1", c("1A","1B")) +
    fixed.factor("Factor2", c("2A","2B")) +
    random.factor("Subject", c("Factor1"))

random.factors(des)
fixed.factors(des)

stopifnot(setequal(names(random.factors(des)), c("Subject")))
stopifnot(setequal(names(fixed.factors(des)), c("Factor1","Factor2")))

show.factorContainer

Output a design factor summary

Description

Output a design factor summary

Usage

show.factorContainer(object)

Arguments

object the factor container to display

subset,factorDesign-method

Subset factor designs

Description

Subset factor designs

Usage

subset(x, ...)

Arguments

x A factorDesign object
... *subset*: Criteria along which to filter in planned observations / design matrix rows., *select*: Names of factors to keep in the design matrix
Value

Returns a factorDesign object with a subsetted design matrix

Examples

```r
des <- fixed.factor("Factor1", c("1A","1B")] +
    fixed.factor("Factor2", c("2A","2B")] +
    random.factor("Subject", c("Factor1")] )

subset(des, select = "Subject")
subset(des, Factor1 == "1A" | Factor2 == "2B", "Subject")
```

write.design  Write Design Files

Description

This function writes a design into a set of files. For each random factor, a unit list is created that contains a list of all levels (instances) of the random factor and the factor levels to which that level is assigned. Moreover, code_files are created that contain a complete set of experimental codes.

Usage

```r
write.design(
  design,
  group_by = NULL,
  order_by = NULL,
  randomize = FALSE,
  run_files = paste0("run", ifelse(length(group_by) > 0L, paste0("_", group_by, "-%", 
    seq_along(group_by), "$s", collapse = ",", "",)),
  code_files = "codes_%s",
  output_dir,
  output_handler,
  file_extension = NULL,
  ...
)
write.design.csv(..., quote = FALSE, row.names = FALSE)
write.design.xlsx(..., format_headers = FALSE)
write.design.json(..., dataframe = "columns")
```
Arguments

- **design**: The factor design to be written into files.
- **group_by**: Experimental codes are to be grouped by these factors. If NULL, all codes are written into one file. Also see `output.design` for grouping design output.
- **order_by**: The experimental codes are to be ordered by these columns. Also see `output.design` for ordering design output.
- **randomize**: After ordering, lines in the same order rank are to be shuffled randomly if set to TRUE.
- **run_files**: The pattern to be used for the file names of the run_files (i.e., files containing the experimental codes). By default, file names are "run_Group1_Othergroup4.ext" etc.
- **code_files**: Code files (files containing conditions for levels of random factors) are named after this pattern.
- **output_dir**: All files are written into this directory.
- **output_handler**: This is the function that is called to write the data frames. If using `write.design.csv`, this is `utils::write.csv` and if using `write.design.json`, this is `jsonlite::write_json`.
- **file_extension**: This is the file_extension to be added after each file name. Use "" if no file_extension is to be added. If 'NULL', the file_extension is guessed from the output_handler used.
- **...**: Other parameters to be passed on to `write.design` and the underlying output_handler.
- **quote**, **row.names**: see `utils::write.csv()`
- **format_headers**: see `writexl::write_xlsx()`, default is FALSE
- **dataframe**: see `jsonlite::write_json()`

Functions

- **write.design.csv**: Using default settings for writing CSV files
- **write.design.xlsx**: Using default settings for writing XLSX files (using the `writexl` package)
- **write.design.json**: Using default settings for writing JSON files (using the `jsonlite` package)

See Also

- `output.design` for use of order_by and group_by.

Examples

```r
des <- fixed.factor("Factor1", c("1A","1B")) +
     fixed.factor("Factor2", c("2A","2B")) +
     random.factor("Subject", c("Factor1"))
```
# This writes a CSV file for each subject and a CSV list of subjects
write.design(des, group_by = "Subject", output_handler = write.csv, output_dir = tempdir())

# This writes a single CSV file for all subjects and a CSV list of subjects
write.design(des, output_handler = write.csv, output_dir = tempdir())
Index

+, factorContainer, factorContainer-method, 2

contrast.names (design.contrasts), 3
design.codes (output.design), 10
design.contrasts, 3
design.formula, 12
design.formula (output.design), 10
design.units (output.design), 10

factor.design, 4
factorContainer-class, 5
factorDesign-class, 6
fixed.factor, 5, 6, 14
fixed.factors (random.factors), 14

is.designFactor (is.randomFactor), 8
is.factorDesign (is.randomFactor), 8
is.fixedFactor (is.randomFactor), 8
is.randomFactor, 8

jsonlite::write_json(), 17

nobs, factorDesign-method, 9

output.design, 5, 10, 17

random.factor, 5, 8, 12
random.factors, 14

show, factorContainer-method
   (factorContainer-class), 5
show.factorContainer, 15

sprintf, 7

subset (subset, factorDesign-method), 15
subset, factorDesign-method, 15

utils::write.csv(), 17

write.design, 5, 16
writexl::write_xlsx(), 17